The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte RICHARD M. KELSO,
PETER V. LANSPEARY,
GRAHAM J. NATHAN, STEVEN J. HILL,
JORDAN J. PARHAM, GRAHAM KELLY,
PHILIP R. E. CUTLER
AND BADRULHISHAM M. GHAZALI

Appeal No. 2005-2271
Application 09/857,204

ON BRIEF

Before KIMLIN, GARRIS, and PAWLIKOWSKI, Administrative Patent Judges.

PAWLIKOWSKI, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1-37. A copy of each of these claims is set forth in the attached appendix.

The examiner relies upon the following references as evidence of unpatentability:

Patterson et al. (Patterson)	384,068	June 5, 1888
Ryschikewitsch	2,044,511	June 16, 1936

Fishbane et al. (Fishbane), Physics for Scientists and Engineers, Prentice-Hall, Inc. page 504 (1993)

NASA Glossary from nas.nasa.gov

Claims 1-32, 34, 35 and 37 stand rejected under 35 U.S.C. § 101, and 35 U.S.C. § 112, second paragraph.

Claims 1, 20-23 and 25-36 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Patterson.

Claims 1-9 and 20-37 stand rejected under 35 U.S.C. § 102 as being anticipated by Ryschikewitsch.

Claim 24 stands rejected under 35 U.S.C. § 103 as being obvious over Patterson.

To the extent that any one claim is specifically and separately argued regarding patentability, we will consider such claim in this appeal. Our consideration of any one particular claim is indicated under each heading below, corresponding to a respective rejection. See 37 CFR § 41.37(c)(1)(vii)(September 2004); formerly 37 CFR § 1.192(c)(7)(2003). Also see Ex parte Schier, 21 USPQ2d 1016, 1018 (Bd. Pat. App. & Int. 1991).

We have carefully reviewed appellants' brief and reply brief, the examiner's answer, and the evidence of record. This review has led us to the following determinations

OPINION

I. The rejection of claims 1-32, 34, 35 and 37 under 35 U.S.C. § 112, second paragraph and 35 U.S.C. § 101

We consider claims 1 and 34 in this rejection.

The examiner's position for this rejection is set forth on

pages 3-5 of the answer.

With regard to the 35 U.S.C. § 101 aspect of this rejection, the examiner states that claims 1 and 34 recite both a product and a method, and therefore are directed to non-statutory subject matter because an invention must only be in a single statutory class. With regard to the 35 U.S.C. § 112, second paragraph aspect of this rejection, the examiner rejects the claims as being ambiguous because claim 1 and claim 34 recite a product and method. On pages 7 and 8 of the brief, appellants disagree with this ground of rejection.

While we appreciate that claim 1, for example, is directed to a fluid mixing device, yet recites "a fluid flow from said first fluid inlet . . . ", we interpret this phrase as a means plus function recitation. The fluid flow from the first fluid inlet and from the second fluid inlet establishing the recirculating vortex system within the chamber is performed by the device. While the claim is not in the classic means plus function format, we interpret the claim as such. We also interpret claim 34 in the same way.

In view of the above, we therefore reverse the rejection of claims 1-32, 34, 35, and 37 under 35 U.S.C. § 112, second paragraph, and under 35 U.S.C. § 101.

II. The 35 U.S.C. § 102 (b) rejection of claims 1, 20-23, and 25-37 as being anticipated by Patterson

We consider claims 1, 21, 25, 27, 28, 33, 34, and 35 in this rejection.[1]

Appellants' position for this rejection is set forth on pages 10-23 of the brief.

With regard to claim 1, appellants argue that Patterson does not anticipate the aspect of claim 1 regarding the fluid flow (recited in the last four lines of claim 1). Appellants allege that the examiner has not asserted that these claim features are explicitly disclosed by Patterson. Appellants also argue that the recitation regarding the fluid flow is not inherent in Patterson. Appellants argue that the fluid flow establishing a recirculating vortex system within the chamber, and resulting in a mixture of fluids from the first fluid inlet and the second fluid inlet being directed through said mixed fluid outlet, would not necessarily result in Patterson. Appellants argue that the examiner has attempted to shift the burden of proof on appellants that Patterson does not inherently possess the claimed features. Brief, pages 10-14.

[1] We note that on pages 20-22 of the brief, appellants merely recite claim features of certain dependent claims, without providing particular arguments as to why these particular features are patentable. We therefore do not consider such claims. See 37 CFR § 41.37(c)(1)(vii)(September 2004); formerly 37 CFR § 1.192(c)(7)(2003). However, beginning on page 22-23, appellants separately argue claims 21, 25, 27, 28 and 35. We accordingly consider these claims.

Appellants also argue that Patterson does not describe a recirculating vortex system and provides reasons therefore. Brief, pages 14-17.

We disagree with appellants' position for the following reasons.

We first refer to the examiner's position as set forth on pages 5-11 of the answer and also as set forth on pages 19-23 of the answer, and incorporate it as our own.

As an initial matter, the claimed phrase "a recirculating vortex system" is given its broadest reasonable interpretation. We note that during patent examination, the pending claims must be interpreted as broadly as their terms reasonably allow. In re Zletz, 893 F.2d 319, 321, 13 USPQ2d 320, 322 (Fed. Cir. 1999). In determining the patentability of claims, the PTO gives claim language its "broadest reasonable interpretation" consistent with the specification and claims. In re Morris, 127 F.3d 1048, 1054, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997)(citations omitted).

As explained by the examiner beginning on page 21 of the answer, turbulent flow is made up of many little vortices. Also, the word "vortex" necessarily requires recirculating, as stated by the examiner on page 21 of the answer. We therefore interpret the claim in the same manner as discussed by the examiner[2], and

[2] We have read appellants' remarks on pages 5-6 of the reply brief regarding the examiner's comments on Fishbane and appellants' comments on Fishbane. However, the issue is the claim interpretation regarding

in this context, we address the issue as to whether the device of Patterson is capable of establishing such a recirculating vortex system, as set forth below.

Contrary to appellants' assertion, it is not necessary that Patterson explicitly disclose a recirculating vortex system. All that is required is evidence that the device of Patterson is capable of establishing a recirculating vortex system. A recitation with respect to the material intended to be worked upon by a claimed apparatus does not impose any structural limitations upon the claimed apparatus, which differentiates it from a prior art apparatus satisfying the structural limitations of that claimed. See Ex parte Masham, 2 USPQ2d 1647, 1648 (Bd. Pat. App. & Int. 1987). Also see In re Rishoi, 197 F.2d 342, 344, 94 USPQ 71, 72 (CCPA 1952); and In re Young, 75 F.2d 996, 997, 25 USPQ 69, 70 (CCPA 1935). Similarly, a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the structural limitations of that claimed. See Ex parte Masham, 2 USPQ 1647, 1648 (Bd. Pat. App. & Int. 1987). Also see In re Yanush, 477 F.2d 958, 959, 177 USPQ 705, 706 (CCPA 1973); In re Finsterwalder, 436 F.2d 1028, 1032, 168 USPQ 530, 534 (CCPA 1971); In re Casey, 370 F.2d 576, 580,

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"vortex" or "recirculating vortex system" and whether the device of the applied art is capable of forming a "vortex" or "recirculating vortex system".

152 USPQ 235, 238 (CCPA 1967); and In re Otto, 312 F.2d 937, 939, 136 USPQ 458, 459 (CCPA 1963).

As discussed on page 22 of the answer by the examiner, there is "reason to believe that the device of Patterson . . . is capable of being used to achieve the acts applicants have included in the claims, including establishing a vortex." We agree. That is, the examiner has established that the device of Patterson meets the structural aspects recited in claim 1. As such, the Patterson device is capable of establishing a recirculating vortex. We refer to the examiner's findings made regarding the structural aspects of the device of Patterson on page 5 of the answer.

Appellants attempt to show that Patterson does not disclose the structural aspects recited in claim 1, beginning at the bottom of page 15 of the brief. Primarily, appellants dispute the finding made by the examiner that the chamber in Patterson comprises the entire volume between the upper plate H and the lower plate F. Appellants argue that the chamber only comprises the volume between upper plate H and lower plate F, and refer to page 1, lines 61-65 of Patterson in this regard.

While Patterson describes that upper plate H is held upon supports J, which rest upon plate F, thereby forming a chamber or generator, Figure 1 of Patterson illustrates a surrounding chamber enclosed by pan A. That is, Figure 1 depicts a chamber

within a chamber. The larger chamber is defined by pan A which surrounds flanges C. Hence, we agree with the examiner's explanation found on page 5 of the answer regarding the fluid mixing device of Patterson. As such, because the structure as described by the examiner on page 5 of the answer meets the components of the fluid mixing device recited in claim 1 (as well as in claim 34), it follows that the device of Patterson is capable of fluid flow from a first fluid inlet and/or from a second fluid inlet, establishing a recirculating vortex system within the chamber, and resulting in a mixture of fluids from the first fluid inlet and a second fluid inlet being directed to a mixed fluid outlet.

Hence, contrary to appellants' position regarding burden of proof, made on page 13 of the brief, the burden does shift to appellants to show that the device in Patterson is not capable of performing the claimed function. See In re Ludtke, 441 F.2d 660, 664, 169 USPQ 563, 566-567 (CCPA 1971) (since alleged distinction between applicants' claims and reference is recited in functional language, it is incumbent upon applicants to show that device disclosed by reference does not actually possess such characteristics).

With regard to claim 33, appellants essentially repeat the same arguments provided for claim 1. Appellants again argue that the chamber in Patterson is defined by top plate H and bottom

plate F. Hence, appellants argue that Patterson does not disclose "a region substantially surrounding said bluff body." Hence, for the same reasons that we affirm the rejection of claim 1, we also affirm the rejection of claim 33.

With regard to claim 34, appellants position is set forth on pages 19-20 of the brief. Appellants essentially provide similar arguments that were provided for claims 1 and 33. Accordingly, for the reasons that we affirm the rejection of claims 1 and 33, we also affirm the rejection of claim 34.

With regard to claim 21, claim 21 recites that the flow divider extends into the chamber. Appellants argue that because the chamber of Patterson is confined between top plate 8 and top plate F, cylinder C is provided around the chamber and therefore does not extend into the chamber. We disagree for the reasons discussed above. That is, Figure 1 of Patterson depicts a chamber within a chamber. As such, cylinder C extends into the chamber that is defined by pan A.

With regard to claim 25, claim 25 recites that the chamber is formed by a generally cup-shaped body with the bluff body disposed at or adjacent an open end. Appellants argue that because the chamber is defined between two chambers F and H, the chamber in Patterson is not formed "by a generally cup-shaped body." We disagree for the reasons discussed, supra (chamber within a chamber).

With regard to claim 27, claim 27 recites that the flow divider extends between the wall of the cup adjacent the open end and the bluff body. Appellants argue that Patterson does not disclose or suggest a cup or a wall of the cup. We disagree. Again, Figure 1 of Patterson discloses a chamber within a chamber. Pan A defines a first chamber, and as such, flanges C, which define the flow divider, extends between the wall of pan A and body H.

With regard to claim 28, claim 28 recites that the flow divider is fixed to the wall of the cup. Appellants argue that cylinder C in Patterson is external to the chamber. We disagree. As discussed, supra, Figure 1 depicts a chamber within a chamber. As such, flanges C are fixed to the wall of pan A by supports c'.

With regard to claim 35, on page 23 of the brief, appellants argue that the fluid entry from the induction port I is not in "substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet." We disagree. As explained supra, Figure 1 of Patterson discloses a chamber within a chamber. As explained by the examiner on page 11 of the answer, Figure 1 depicts that a direction of fluid entry to the chamber from said first fluid inlet (liquid fuel is fed through pipe D) is substantially opposite a direction of fluid entry to said chamber from say at least one second fluid inlet (the second fluid inlet being at the top circumference (at c').

In view of the above, we affirm the 35 U.S.C. § 102(b) of claims 1, 20-23 and 25-37.

III. The 35 U.S.C. § 103 rejection of claim 24 as being obvious over Patterson

Claim 24 recites the ratio h/L as about 0.4. This value concerns the spacing h, which is the height from the base of the chamber, and L, which is the distance of the lower or opposite end of the cup to the bluff body. See appellants' Figure 15, for example. The examiner's position is that the value of 0.6 would have been obvious because it would have been obvious to one of ordinary skill in the art to have optimized the spacing of the inlet and/or bluff body to create a particular air flow. Absent any evidence of criticality, we agree with the examiner's position.

In view of the above, we affirm the 35 U.S.C. § 103 rejection of claim 24 as being obvious over Patterson.

IV. The 35 U.S.C. § 102(b) rejection of claims 1-9 and 20-37 as being anticipated by Ryschkewitsch

We consider claims 1, 3, 9, 33, 34, and 35 in this rejection.[3]

The examiner's position for this rejection is set forth on pages 11-18 of the answer. Appellants' position regarding this

[3] The examiner states that the embodiment of Figures 3 and 4 anticipates claims 5-7, which require that the bluff body includes a centrally disposed aperture. We note that appellants only separately argue claims 3, 9, and 35 (see pages 34-35 of the brief). Appellants also separately argue claim 33 and claim 34 (see pages 30-32 of the brief). We limit our consideration to these separately argued claims,

rejection is set forth on pages 25-35 of the brief.

Again, the primary issue is whether the device of Ryschkewitsch is capable of the function recited in the claims.[4] We refer to the examiner's findings made on pages 11-12 of the answer regarding the structural aspects of the device disclosed in Ryschkewitsch.

With regard to claim 1, beginning on page 27 of the brief, appellants argue that if the chamber in Ryschkewitsch is considered the entire space in the housing 1, then the inset body 8 of Ryschkewitsch is not a bluff body defining one end of the chamber. Appellants argue that the inset body 8 really defines almost the entire interior space. We are not convinced by this argument. As pointed out by the examiner on page 25 of the answer, the inset body 8 includes plate 8' which defines one end of the chamber.

Appellants also argue that rib 7 cannot properly be considered a flow divider defining at least one second fluid inlet to said chamber and at least one mixed fluid outlet from said chamber. Appellants argue that rib 7 is entirely contained within the housing 1. Brief, pages 27-28. We disagree. As pointed out by the examiner on page 25 of the answer, item 7

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including claim 1.

[4] Again, contrary to appellants' assertion that Ryschkewitsch must explicitly disclose a recirculating vortex system (see page 27 of the brief), all that is required is that the device of Ryschkewitsch be capable of performing the function, as discussed, supra.

denotes a ribbed annulus which clearly divides inlet and outlet flow and therefore can be considered a flow divider.

Appellants also argue that if the combustion space shown in Figures 1 and 2 of Ryschkewitsch (between rib 7 and inset body 8) is considered the chamber, that only a single inlet for the mixed fluid is defined at the lower end of the chamber. We disagree. As pointed out by the examiner, Figure 1 of Ryschkewitsch depicts a first fluid inlet shown near item 2 of Figure 1 and a second fluid inlet shown near item 10 of Figure 1.

On pages 28-29 of the brief, appellants argue the embodiments shown in Figures 3 and 4. We need not discuss these embodiments with regard to the patentability of claim 1 because the embodiment shown in Figures 1 and 2 anticipate the claim, as discussed supra. We note that on page 11 of the answer, the examiner explains that both embodiments (embodiment of Figures 1 and 2 and the embodiment of Figures 3 and 4) anticipate all the independent claims. The examiner indicates that some of the dependent claims are only anticipated by the embodiment shown in Figures 3 and 4 (dependent claims 3 and 9).

With regard to independent claim 33, appellants argue the patentability of claim 33 for essentially the same reasons appellants argue the patentability of claim 1. Hence, for the reasons that we affirm the rejection of claim 1, we also affirm the rejection of claim 33.

With regard to independent claim 34, appellants again argue that Ryschkewitsch does not suggest a combination of a chamber, a bluff body, and a flow divider as recited in claim 34. We disagree for the same reasons that we affirm the rejection of claims 33 and 34.

With respect to dependent claim 35, claim 35 recites that a direction of fluid entry into the chamber from the first fluid inlet is substantially opposite a direction of fluid entry to the chamber of at least one second fluid inlet. Appellants argue that each embodiment in Ryschkewitsch only discloses an upward fluid flow of both the fuel and the air to the combustion space and the embodiment in Figure 1 also discloses a lateral entry of air into housing 1 through opening 7. Appellants argue that neither embodiment discloses fluid entry downward, in opposition to the fluid entry from the nozzles 3. We disagree. Figure 1 shows air flow entering through opening 7 (indicated by the downward arrow) which is a direction opposite the arrow entering near item 2 in Figure 1. Hence, opposite flow does occur as depicted in Figure 1.

With regard to claim 3, claim 3 recites that the egress means include material porous to the fluids forming at least part of the bluff body. Appellants argue that Ryschkewitsch does not disclose any material that is porous to fluids as recited in claim 3. The examiner interprets the word "porous" as

encompassing openings. That is, on page 26 of the answer, the examiner states that Figures 1 and 4 of Ryschkewitsch depict bluff body (8' or 17, respectively) having openings, and that these openings make them porous to fluids. We agree.

With regard to claim 9, claim 9 recites that "alternate ones of said flow channels spaced around said bluff body respectively form said second fluid inlets and said mixed fluid outlets". Appellants argue, on page 35 of the brief, that there is no basis for distinguishing the openings in Figure 4 of Ryschkewitsch as inlets or outlets, let alone that "alternate ones of said flow channels respectively form said second fluid inlets and said mixed fluid outlets" as recited in claim 9. Claim 9 depends upon claim 8 and claim 8 depends upon claim 1. Claim 8 recites that the flow divider defines a series of flow channels which form the second fluid inlets and mixed fluid outlets.

The examiner finds item 17 of Figure 3 as a bluff body. See top of page 12 of the answer. The examiner finds the more radially outward annulus of 17 and radial ribs 18 of Figure 3 and 4 as a flow divider. The examiner finds the space between the more radially outward annulus 18 and the inner wall of the housing 1 of Figure 3 as defining a second fluid inlet. See page 12 of the answer. It is in this context that the examiner finds that the embodiment of Figures 3 and 4 discloses the subject matter of claim 9. See the paragraph bridging pages 13-14 of the

answer.

The examiner responds to appellants' position regarding claim 9, at the bottom of page 26 and at the top of page 27, of the answer. Essentially, the examiner's response reflects the examiner's position that the device in Ryschkewitsch is capable of fluid flow wherein "alternate ones of said flow channels respectively form said second fluid inlets and said mixed fluid outlets". Because of the structural findings made by the examiner regarding the device of Ryschkewitsch, as discussed, supra, we agree. Appellants have not shown that the device of Ryschkewitsch is not capable of such function. See In re Ludtke, 441 F.2d 660, 664, 169 USPQ 563, 566-567 (CCPA 1971).

In view of the above, we affirm the 35 U.S.C. § 102(b) rejection of claims 1-9 and 20-37 as being anticipated by Ryschkewitsch.

V. Conclusion

The rejection of claims 1-32, 34, 35 and 37 under 35 U.S.C. § 101 and under 35 U.S.C. § 112, second paragraph is reversed.

Each of the art rejections is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(1)(iv)(effective Sept. 13, 2004; 69 Fed. Reg. 49960 (Aug. 12, 2004); 1286 Off. Gaz. Pat., Office 21 (Sept. 7, 2004)).

AFFIRMED-IN-PART

Edward C. Kimlin)
Administrative Patent Judge)
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)
Bradley R. Garris) BOARD OF PATENT
Administrative Patent Judge) APPEALS AND
) INTERFERENCES
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)
Beverly A. Pawlikowski)
Administrative Patent Judge)

BAP/cam

APPENDIX

1. A fluid mixing device including a chamber, a bluff body defining one end of the chamber, a first fluid inlet disposed toward an opposite end of the chamber from said bluff body and arranged to direct fluid toward said bluff body, a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet to said chamber and at least one mixed fluid outlet from said chamber, a fluid flow from said first fluid inlet and/or from said second fluid inlet establishing a recirculating vortex system within said chamber and resulting in a mixture of fluids from said first fluid inlet and said second fluid inlet (s) being directed through said mixed fluid outlet (s).

2. A fluid mixing device as claimed in claim 1 wherein said bluff body includes egress means for releasing fluid from said chamber.

3. A fluid mixing device as claimed in claim 2 wherein said egress means include material porous to said fluids forming at least part of said bluff body.

4. A fluid mixing device as claimed in claim 2 wherein said egress means include one or more apertures through said bluff body.

5. A fluid mixing device as claimed in claim 4 wherein said bluff body includes a centrally disposed aperture.

6. A fluid mixing device as claimed in claim 5 wherein said first fluid inlet is directed substantially toward said centrally disposed aperture.

7. A fluid mixing device as claimed in claim 6 wherein said aperture has a circular cross section.

8. A fluid mixing device as claimed claim 1 wherein said flow divider defines a series of flow channels which form said second fluid inlets and said mixed fluid outlets.

9. A fluid mixing device as claimed in claim 8 wherein alternate ones of said flow channels spaced around said bluff body respectively form said second fluid inlets and said mixed fluid outlets.

10. A fluid mixing device as claimed in claim 9 wherein said flow divider has a corrugated profile so as to repeatedly cross said region surrounding the bluff body.

11. A fluid mixing device as claimed in claim 10 wherein said chamber includes an outer wall extending substantially around the perimeter of said region surrounding the bluff body.

12. A fluid mixing device as claimed in claim 11 wherein said corrugated profile alternately contacts the bluff body and said outer wall.

13. A fluid mixing device as claimed in claim 12, wherein the geometric center of a cross-section of each of the flow channels defined by said corrugated profile is substantially equidistant from the bluff body and from the outer wall.

14. A fluid mixing device as claimed in claim 12, wherein the geometric centers of the cross-section of each of the flow channels defined by said corrugated profile are alternately substantially closer to the outer wall and substantially closer to the bluff body.

15. A fluid mixing device as claimed in claim 14 wherein the flow channels having cross-sections with geometric centers substantially closer to the outer wall form said second fluid inlets and the flow channels having cross-sections with geometric centers substantially closer to the bluff body form said mixed fluid outlets.

16. A fluid mixing device as claimed in claim 10 wherein said corrugated profile is of triangular form said that said flow channels are generally triangular in cross-section.

17. A fluid mixing device as claimed in claim 16 wherein at least alternate flow channels have substantially the same cross section size.

18. A fluid mixing device as claimed in claim 17 wherein said corrugated profile defines eight flow channels forming second fluid inlets each alternately interposed with eight flow channels forming mixed fluid outlets.

19. A fluid mixing device as claimed in claim 18 wherein the mixing device has eight-fold azimuthal symmetry about a longitudinal axis.

20. A fluid mixing device as claimed in claim 1 wherein the flow divider protrudes beyond said bluff body.

21. A fluid mixing device as claimed in claim 1 wherein the flow divider extends into said chamber.

22. A fluid mixing device as claimed in claim 1 wherein said first fluid inlet is spaced toward said bluff body from said opposite end of the chamber.

23. A fluid mixing device as claimed in claim 22 wherein the space h of the first fluid inlet from said opposite end satisfies the relationship $0<h/L<1$

where L is the distance from the opposite end to the bluff body.

24. A fluid mixing device as claimed in claim 23 wherein the ratio h/L is about 0.4.

25. A fluid mixing device as claimed in claim 1 wherein said chamber is formed by a generally cup-shaped body with said bluff body disposed at or adjacent an open end.

26. A fluid mixing device as claimed in claim 25 wherein said first fluid inlet is centrally disposed in the base of said cup.

27. A fluid mixing device as claimed in claim 25 wherein said flow divider extends between the wall of said cup adjacent the open end and said bluff body.

28. A fluid mixing device as claimed in claim 27 wherein said flow divider is fixed to the wall of said cup.

29. A fluid mixing device as claimed in claim 1 wherein said mixing device is a burner.

30. A fluid mixing device as claimed in claim 29 wherein said first fluid inlet supplies combustible fuel and said second fluid inlets supply air to the chamber.

31. A fluid mixing device as claimed in claim 30 wherein said combustible fuel is a gaseous fuel.

32. A fluid mixing device as claimed in claim 30 wherein said combustible fuel is a gaseous hydrocarbon fuel.

33. A fluid mixing device including a chamber, a bluff body defining one end of the chamber, a first fluid inlet disposed toward an opposite end of the chamber from said bluff body and arranged to direct a first fluid toward said bluff body, a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet configured to provide a second fluid to said chamber and at least one mixed fluid outlet configured to emit a mixture of said first fluid and said second fluid from said chamber while said at least one second fluid inlet provides a second fluid to said chamber, said first and second inlets and said mixed fluid outlet being configured and positioned so that a fluid flow from said first fluid inlet and said at least one second fluid inlet establishes a recirculating vortex system within said chamber that mixes said first fluid and said second fluid.

34. A fluid mixing device including a chamber, a bluff body defining one end of the chamber, a first fluid inlet disposed toward an opposite end of the chamber from said bluff body that directs a first fluid toward said bluff body, a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet to said chamber that provides a second fluid and at least one mixed fluid outlet from said chamber that emits a mixed fluid, a fluid flow from said first fluid inlet and said at lest one second fluid inlet establishing a recirculating vortex system within said chamber and a mixture of fluids from said first fluid inlet and said at least one second fluid inlet being emitted through said mixed fluid outlet.

35. The fluid mixing device of claim 1, wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet.

36. The fluid mixing device of claim 33, wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet.

37. The fluid mixing device of claim 34, wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet.

Greenblum & Bernstein, P.L.C.
1950 Roland Clarke Place
Reston, VA 20191